A Guide to the Geology of the Carlinville Area, Macoupin County, Illinois

Dwain Berggren

Field Trip Guide Leaflet 1979-D
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Illinois State Geological Survey
Urbana, Illinois 61801

COVER: Th le
near route mileage 12.55. Abandoned since 1954, the concrete-beam structure supported coal-hoisting and -cleaning machinery. The vertical shaft directly below the large pulley wheel descends about 235 feet to the Herrin (No. 6) Coal seam.

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GEOLOGICAL SCIENCE FIELD TRIPS are free tours conducted by the Educational Extension Section of the Illinois State Geological Survey to acquaint the public with the geology and mineral resources of Illinois. Each is an all-day excursion through one or several counties in Illinois; frequent stops are made for explorations, explanations, and collection of rocks and fossils. People of all ages and interests are welcome. The trips are especially helpful to teachers in preparing earth science units. Grade school students are welcome, but each must be accompanied by a parent. High school science classes should be supervised by at least one adult for each ten students. A list of previous field trip guide leaflets is available for planning class tours and private outings.

April 26, 1980. EQUALITY, Gallatin and Saline Counties.

May 17, 1980. HILLSDALE, Rock Island and Whiteside Counties.

the geologic framework

<u>A picture of the area.</u> If a long, deep trench were dug across Macoupin County, we could see in its sides the different layers of earth and rock that lie under the land surface. Figure 1 shows just such a side view of a trench extending about 14 miles between Carlinville and Gillespie. This kind of drawing is called a geologic section. Different patterns in the geologic section represent the sequence of earth and rock layers that lie within about 300 feet of the land surface. Now let us look at this picture a piece at a time and from the bottom up.

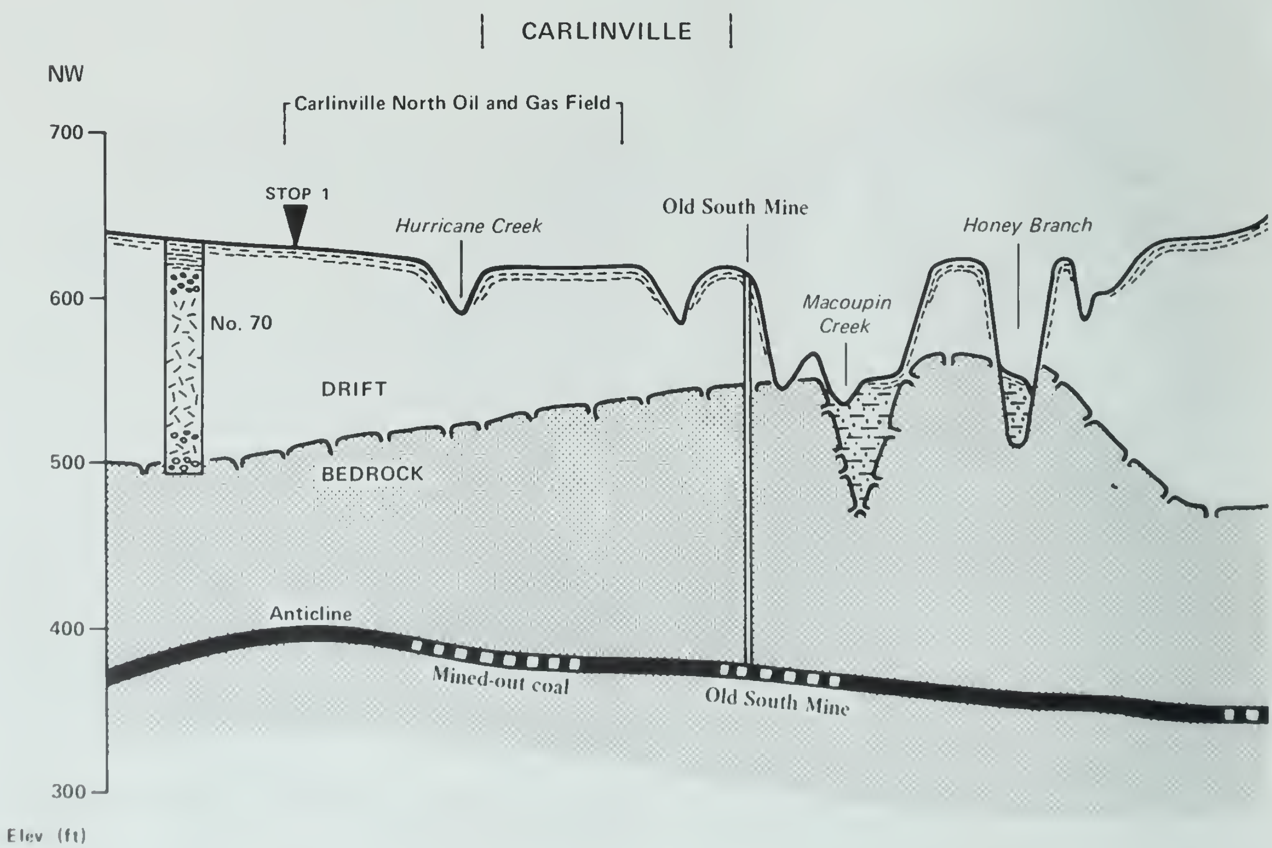
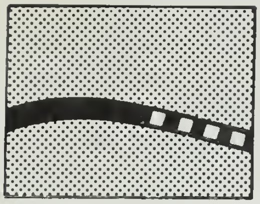


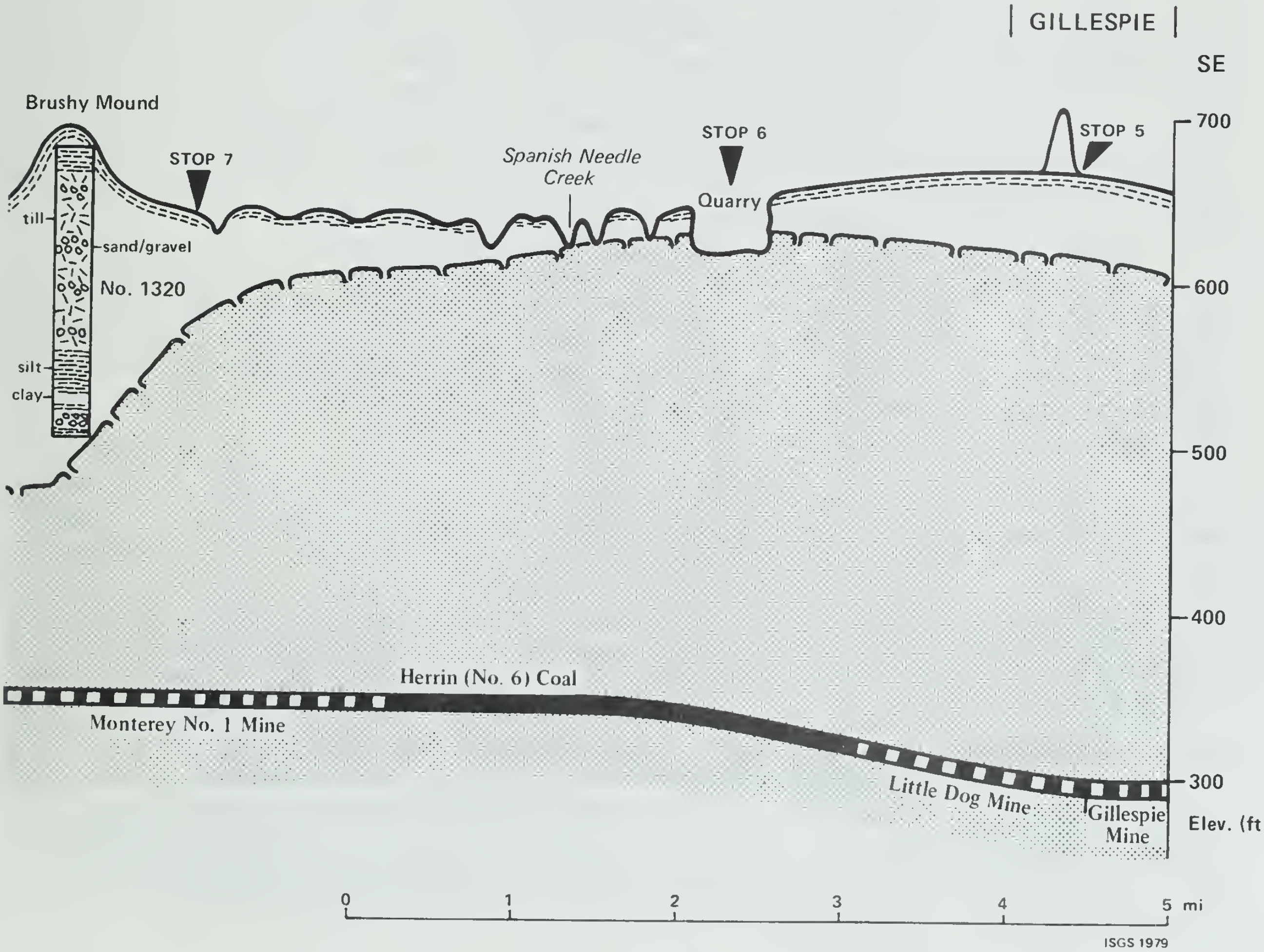
Figure 1. A geologic section across the field trip area.



Bedrock: the Pennsylvanian rocks. In the field trip area, the solid rock (bedrock) under the glacial drift consists of thick layers of mudstone and sandstone with thinner layers of coal and limestone between them. These are sedimentary rocks, which were once **sediments**—loose, soft muds and sands. The sediments were deposited during the Pennsylvanian Period, the time between about 320 and 280 million years ago.

During the Pennsylvanian Period, Illinois and most of the Midwest were part of a tropical region that was covered by shallow seas and swampy, forested river deltas and river floodplains. The region was a part of the Earth's crust that was sinking very slowly in such a way that areas within it were repeatedly and alternately covered by shallow seas and by swampy land. Muds, chalky muds, and shell sands that accumulated on the sea bottoms became mudstone and limestone beds. The muds, sands, and thick peat beds that accumulated in the deltas and floodplains became mudstone, sandstone, and coal seams. Sets of marine beds alternate with sets of lowland beds.

The Pennsylvanian beds in Macoupin County have provided substantial resources: clay, stone, petroleum and natural gas, and coal. Pennsylvanian shale was used to make brick and tile in Carlinville. The thin Pennsylvanian limestones that crop out along the streams were quarried during the settlement period for building stone and lime. More recently, small quarries have operated to make broken stone for agricultural lime, surfacing materials, and aggregates.

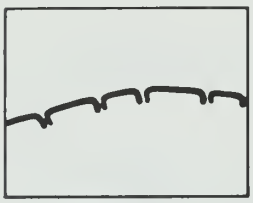


Parts of the deepest sandstone beds in the Pennsylvanian System contain petroleum and natural gas. Some of the Macoupin County oil and gas fields were among the state's early discoveries. None of the fields have been large producers, but the early discoveries here and in other shallow producing areas, which often were found by chance or in the course of drilling for coal, did encourage further exploration for petroleum and the development of the industry.

The Carlinville North Oil and Gas Field is shown on the geologic section. The producing sandstone is about 220 feet below the Herrin (No. 6) Coal Member (below the area shown in figure 1). The coal seam shows the slight arch of the Pennsylvanian beds that forms the structural trap for oil and gas.

Small supplies of water are obtained from shallow Pennsylvanian sandstones in northern Macoupin County. Water from deeper bedrock is generally too salty and mineral-laden to use.

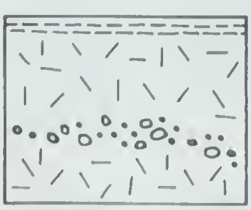
The older Paleozoic rocks. Below the Pennsylvanian beds are older layers of mudstone, limestone, dolostone, and sandstone. The sediments that formed these rocks accumulated on the floors of Paleozoic seas that began to cover the Midcontinent during the early part of the Paleozoic Era, which began about 570 million years ago. The Paleozoic rocks covered a landscape carved by millions of years of erosion in Precambrian granites that were formed between about 1.5 and 1.2 billion years ago. In the Carlinville area Paleozoic bedrock—including the Pennsylvanian beds—is about 5,100 feet thick.



Pennsylvanian-Quaternary unconformity. The broken line on top of the Pennsylvanian bedrock represents the ancient land surface that the glaciers buried. After the Paleozoic Era, Illinois and the rest of the Midcontinent rose above sea level. From this time until the glaciations began—over a period of possibly 200 million years—streams eroded the land and cut away a several-thousand-foot thickness of bedrock across Illinois. The old bedrock land surface cut by stream erosion was smoothed and gouged out to some extent by the glaciers and their meltwater before they buried it.

The old land surface is also an unconformity—the surface of contact between glacial deposits that are perhaps 2 to 3 million years old and bedrock that is about 300 million years old. If we think of the layers of sediment and rock in the Earth's crust as pages in a book telling the geologic history of the Earth, then unconformities are missing pages that were never written or that were torn out of the book by erosion.

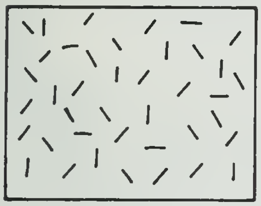
The unconformity shows two low parts—one is a buried valley under Brushy Mound, and the other a larger buried valley, the south side of which is under Stop 1. (Its center is 3 miles north of the stop). The two buried valleys, unlike the county's present day streams, run straight west. They join in Greene County to empty into the Illinois Valley. Although the eastern two-thirds of the old valley system is buried, the lower course of Macoupin Creek runs in the old bedrock valley in Greene County between Riverdale and the Illinois Valley.



Glacial Drift. The bedrock in Macoupin County, and in 90 percent of Illinois, is covered by a blanket of drift. The term "drift" identifies all the sediments—the muds, sands, gravels, and larger rocks—deposited by winds, meltwater streams, and glaciers as a result of glaciation. Drift includes such materials as till, outwash, ice contact deposits, and loess.

In the past two to three million years, the Earth's climate has repeatedly cooled and warmed, perhaps 20 to 25 times. During the cooler periods, thick snow fields accumulated across the continents at mid-Canadian latitudes and became ice sheets. The broad, flowing southern edges of these ice sheets were the glaciers that covered parts of Asia, northern Europe, and the United States. Glaciers entered Illinois from the northwest, north, and northeast and are estimated to have been as much as 5,000 feet thick.

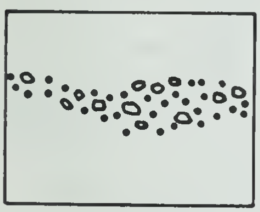
Macoupin County has been glaciated several times. Drill holes, excavations, and stream cuts in the drift reveal layer upon layer of till and outwash left by different glaciers and their meltwater streams. Some of these deposits, recorded in the logs of two test holes drilled near the line of section, are shown: ISGS County No. 70 near Stop 1 and County No. 1320 near Brushy Mound. The geologic section does not show more detail because the different drift layers have not been well identified and mapped across the county. The last glacier to cover Macoupin County possibly entered the area between 200 and 300 thousand years ago during the Illinoian glaciation.



Glacial Drift: till. Till is the sandy, gravelly mud that is made, carried, and laid down by glaciers. A glacier can smear down a till layer as it flows or let down a layer as it melts. A typical till is a hard, compact mixture of all sediment sizes: mostly clay, silt, and sand mixed with smaller amounts of pebbles, cobbles, and boulders. Often each glacier deposited a till sheet with a distinctive color and composition.

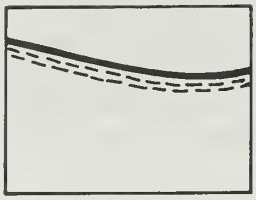
The till deposits, which make up the bulk of the drift in this area, fill in and cover the land surface of the old bedrock and form the level, thick-soiled plain so well-suited to mechanized agriculture. The sandy, gravelly soils formed from weathered till occupy about 15 percent of the county's area, but are not generally suited to cultivation because they occur on the steep, wooded and gullied hillsides along streams where slopewash has stripped off the covering loess.

Deep clayey till deposits in the area are good places to bury wastes because fluids move through them very slowly and are partly cleaned by filtering and chemical reactions with the clays.



Glacial drift: outwash sand and gravel. Buried in the till sheets are bodies of sand and gravel deposited by meltwater streams running off the glaciers. The great volumes of meltwater eroded rock debris and mud from the ice. The streams washed and winnowed these sediments and deposited them, roughly sorted by size, in the water courses draining the ice fields.

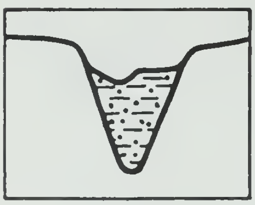
In many parts of the glaciated Midwest outwash deposits provide large supplies of water and construction materials. This is not true in Macoupin County, however. Here most buried outwash layers are too thin and small in extent to yield much water. Large-diameter (36-inch) wells drilled into the shallower of these deposits, the thin gravel layers, provide enough water for home use. Livestock farms, cities, and industries draw the large volumes of water they need from the many constructed ponds and lakes in the county. No thick or extensive surface deposits of glacial sand and gravel suitable for surfacing and aggregate material occur in the county.



Glacial drift: loess. A blanket of windblown dust called loess covers the upland plain. The dust is rock "flour"—silt-sized grains formed when the glaciers rubbed the rocks they carried against each other and against bedrock. The dust was blown out of the Mississippi and Illinois River Valleys during the last glaciation, the Wisconsinan. The Wisconsinan glaciation began 50 to 75 thousand years ago and ended about 7 thousand years ago.

Twice during the Wisconsinan glaciation, glaciers advanced into Illinois and spilled their meltwaters into the Mississippi and Illinois Valleys. The meltwaters that flooded the valleys carried great quantities of rock flour and deposited it across the flooded valley floors. In the winter as the glaciers' melting slowed, the meltwater floods receded, and the bare floodplains dried out. Winter windstorms from the northwest blew dust off the floodplains and out of the valleys and carried it southeast across the state. The loess blanket covering Macoupin County is about 8 feet thick on the western side (closer to the source valley) and thins to about 4 feet on the east (farther from the source valley).

In Carlinville, weathered loess was mined to make brick and tile. More significantly, about 77 percent of the county's area—the better farm land—is covered by loess soils. Loess is an excellent soil material—a readily crumbled seed bed that is fertile, water conducting, and free of equipment-damaging large rocks. Loess erodes very easily, however, and the loess soils on slopes have been heavily damaged by gullying and sheet erosion since the area came under cultivation.



Alluvium. Alluvium is the sediment that streams carry and deposit. Since the last glacier began to melt off the field trip area, running water has been eroding stream valleys into the plain and carrying mud, sand, and gravel down them. About 8 percent of the county's land area is valley bottom land with alluvial soils which are rich but wet and regularly flooded.

Note in the geologic section that the valleys of Macoupin Creek and Honey Creek extend down below their present floors and are partly filled with alluvium. This is the case with all the larger streams in Illinois. Here the valleys seem to have been cut to their greatest depth at some time after the Illinoian glacier melted off the land. Later a change in climate or a raising of the stream's discharge level caused them to partly fill their valleys with alluvium. The loess cover on the higher levels of the alluvial fill (the terraces, the steplike deposits along the valley sides) indicates that alluvial filling occurred before all the Wisconsinan loess was deposited—perhaps before 50 to 75 thousand years ago.

Some sketchy well logs indicate that the deeper alluvium is mostly fine mud—silts and clays—and some thin sand and gravel layers.

The alluvium deposited during and since the Wisconsinan glaciation is largely silt eroded from the loess. Sand and gravel deposits occur in the alluvium, but apparently they are too small to mine. Evidently they are not clean enough to serve as good aggregates because they contain ironstone and shale pebbles from the Pennsylvanian bedrock and rust pellets washed from the soils.

guide to the route

Start at the entrance to the parking lot on the west side of Carlinville High School. The route and stops are marked on topographic maps shown on the following pages.

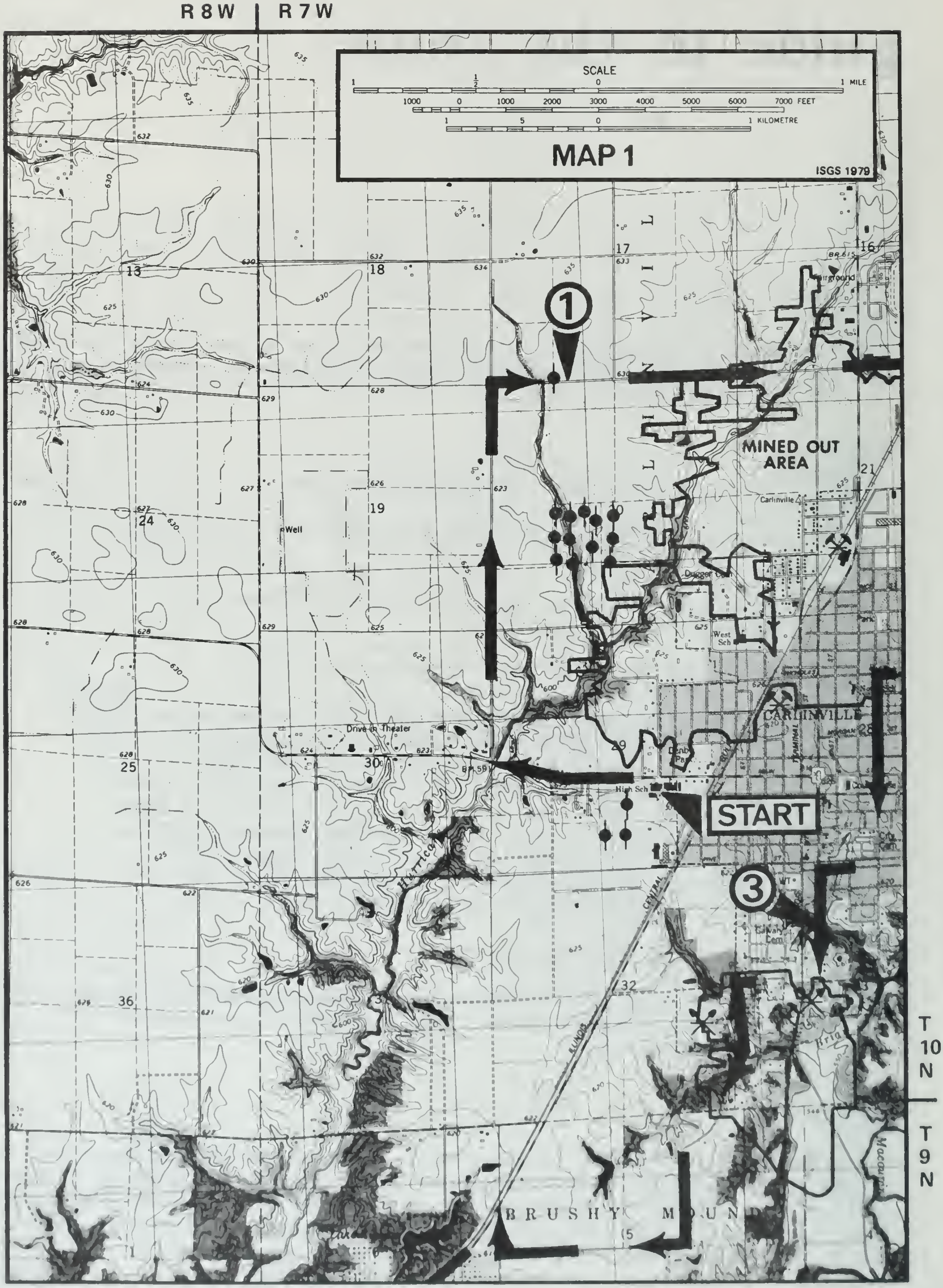
At mile		
0.0	Turn left (west) onto State Route 108. Go....	0.7 mile
	We cross the south end of the abandoned Carlinville North Oil and Gas Field.	
0.7	Turn right (north) at the west end of the bridge over Hurricane Creek. Go....	1.5
2.2	Turn right (east) at the T-intersection. Go....	0.3
	<u>Contour lines on a topographic map.</u> Look at the patterns that the kinked and winding contour lines make on the route map. Each contour line represents a line of points on the land surface that are the same height, or elevation, above average sea level. Walking along a contour line, we would walk a horizontal, level path. Contour lines outline landforms. Notice that the outlines of the contours around streams and their valleys are shaped like plant roots. Such stream patterns are called dendritic.	
2.5	Stop 1 is a view from the road.	

STOP 1. Views of the glacial plain and the site of the abandoned Carlinville Oil and Gas Field. 1,500 feet east of the northwest corner of Section 20, T. 10 N., R. 7 W., Macoupin County, Carlinville West 7.5-minute Quadrangle.

STOP 1

The Glacial Plain

The plain we see stretching to the horizon was formed by the glaciers that flowed across Macoupin County and much of the Midwest in the past two to three million years, during the time interval known as the "Ice Age" and also as the Pleistocene Epoch. The last glacier to cover the county possibly entered it and melted away between 200 and 300 thousand years ago leaving the plain essentially as we see it now. The 4- to 6-foot thickness of loess that blanketed



R 8 W
R 7 W
SCALE
1 MILE
7000 FEET
1 KILOMETRE
MAP 1
ISGS 1979
MINED OUT AREA
START
Carlinville
CARLINVILLE
Drive-in Theater
Well
High Sch
West Sch
BRUSHY MOUND
T 10 N
T 9 N

the land between about 75 thousand and 7 thousand years ago probably made the plain a little smoother.

The plain becomes visible whenever we cross the wide uplands between the stream valleys in this region. An idea of its flatness can be gained by observing that the general elevation of the plain near this stop (about 630 feet above sea level) is only about 35 feet lower than the plain around Stop 5 at Gillespie, which is 12 miles to the south at the end of our field trip route. The drift here at Stop 1 is about 120 feet thick underfoot.

The Carlinville North Oil and Gas Field

The Carlinville North Field is south of us, between this stop and the high school. The Ohio Oil Company drilled the first producing oil wells here in 1914 on the A. Braun farm in Section 20. At least one well was drilled in 1921. More drilling began in 1941. Map 1 shows the location of the wells in the pool that are known to have been producers. The Carlinville North Field produced oil and gas from Pennsylvanian sandstone beds, which are about 220 feet below the Herrin (No. 6) Coal and 450 to 500 feet below the land surface. The field was abandoned in 1954.

In the Carlinville North field, petroleum, natural gas, and salt water fill spaces between the sand grains in the rock. The sandstone and other rock layers are warped up into a low dome. Oil and gas are confined in the sandstone within the dome and are covered by unbroken fine-grained rock such as mudstones through which the oil and gas cannot pass. The oil and gas are held in the dome much as an air bubble is held in the top of an inverted bowl submerged in water. The other oil and gas fields in the area produce from the same or very similar rock units and structures.

The Litchfield discovery. The first oil field in Illinois was developed at Litchfield 15 miles southeast of here. One could say that the first oil produced at Litchfield was mined. In 1879, the Litchfield Coal Company, attempting to find a second coal seam below the one it was mining, drilled a test hole at the bottom of its mine shaft. At 255 feet below the mine floor, the drill penetrated a sandstone bed that ran saltwater and oil. To prevent the mine's flooding, the operators plugged the hole; however, oil continued to leak into the mine, and for several years it was skimmed off the water in the mine sump and sold for lubricating oil.

No oil boom followed the Litchfield discovery, but a few more wells were drilled. State Geologist A. H. Worthen reported that in 1882 four wells at Litchfield were yielding about two barrels of oil per day each. Another well drilled in 1882 produced a large volume of natural gas and led to the development of a gas field and pipeline system to supply light and fuel to Litchfield. In 1886 the Litchfield Gas, Oil, and Fuel Company was supplying gas to about 500 stoves in the town, but by 1889 the gas field was nearly exhausted. Litchfield, like other fields in small structures of Pennsylvanian sandstones, was a short-term, small producer. However, from 1879 until 1902 this field yielded the only gas and oil produced in Illinois.

The Carlinville South discovery. The first oil and gas field discovered in the Carlinville area is about 5 miles south of here in Brushy Mound Township. A well digger's mishap more than a hundred years ago is thought to have led to its discovery. The man was digging a water well in the drift and lighted his pipe in the well. The flame ignited gas that had seeped into the

well and set his clothing on fire. The gas was probably a small quantity of drift gas, not "rock" gas, but as a consequence of the incident an unsuccessful well was drilled in 1867. In 1909, the Impromptu Exploration Company began drilling nearby, perhaps sensing that the other people must have been on to something. The company indeed struck gas and developed what is known as the Carlinville South Field, which was abandoned in 1964. This field's discovery stimulated more drilling and the discovery of other fields in the Carlinville area. Although the region's small oil and gas fields have supplied an insignificant fraction of the fuel produced in Illinois, they did help found the state's oil and gas industry.

At mile

2.5	Leave Stop 1 and go straight ahead (east) to State Route 4. Go...	1.2 mile
3.7	Stop and cross Route 4. Cross the unguarded railroad crossing ahead with caution. Go...	0.3
4.0	Pass T-intersection. Go straight ahead (east)...	2.7
	<u>Abandoned mine.</u> The shaft and works of the Standard Oil Company Mine No. 1 were located 0.2 mile south of this intersection. The mine worked the Herrin (No. 6) Coal seam about 300 feet below the surface. The seam was about 6 feet 6 inches thick here. The mine was abandoned in 1925 and later its surface structures were razed.	
6.7	Go straight ahead (east) through the T-intersection and down the hill. Prepare to turn right on the curve. Go...	0.15
6.85	Turn right (south) onto the gravel drive in front of Moore Cemetery. Follow the drive around to Stop 2, which is the cut along the blacktop road between the drive and the bridge.	

STOP 2

STOP 2. Drift in the road cut at Moore Cemetery. SE corner of SE¼SW¼SE¼ Sec. 13, T. 10 N., R. 7 W., Macoupin County, Carlinville East 7.5-minute Quadrangle.

<u>The roadcut.</u> About a quarter-million years of Macoupin County history are revealed in the roadcut between the Moore Cemetery and the bridge. In that time winds, streams, and glaciers deposited the different layers of sediment that we see in the cut's 30-foot thickness of drift. This is the material that underlies the glacial plain in most of the area. Figure 2 describes the deposits and their history.

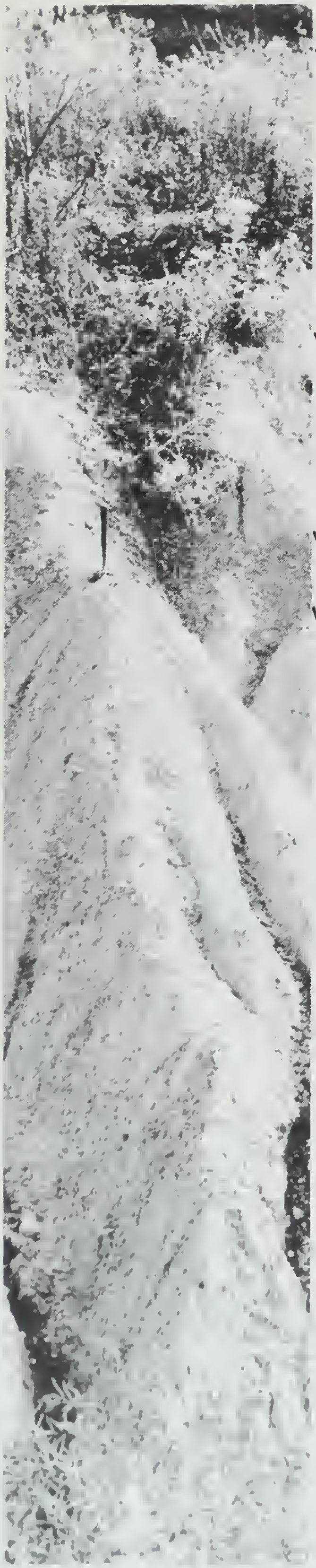
As you examine the outcrop, be sure to locate the 30-inch gravel bed buried in the till about 12 to 15 feet above the ditch bottom. Under the plain, this sand and gravel bed, and others like it, are saturated with water and are called aquifers or water-yielding deposits. The wells penetrating them yield small quantities of water suitable for home supplies. Sand and gravel beds that emerge along the sides of valleys, as this one does, may discharge water to

R 7 W


SCALE
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETRE
MAP 2
ISGS 1979
Leefers Landing Strip
Fairground
CARLINVILLE
Moore Cem
Carlinville Country Club
KLIMUT LANDING STRIP
RAILROAD GRADE
BRUSHY MOUND
Lake Williamson Christian Center
Macoupin Cr
TERMINAL
ILLINOIS

T 10 N

T 9 N



DESCRIPTION	HISTORY	
6 in. Silt, very pale brown 4 ft 6 in. Silt, strong brown depth 5 ft	4. During the last glaciation, winds blow loess onto this area—weathering and vegetation continue to form a forest soil in the Loess.	WISCONSINAN DRIFT 50,000 to 75,000 years until 7,000 years ago
7 ft Pebbly loam; strong brown mottled reddish yellow and dark brown. Plants overgrow this zone.	The land surface from the time the glacier melts until the loess falls on it . . . (Top 7 ft is the Sangamon Soil Zone—weathering during the Sangamonian changes the top part of the till into soil.)	SANGAMON SOIL developed between the Illinoian and Wisconsinan glaciations
5 ft Sandy, gravelly mud; pale yellow and a few cobbles and boulders depth 17 ft	3. The glacier flows back across the area and deposits 12 ft of till.	ILLINOIAN DRIFT deposited perhaps 200,000 to 300,000 years ago
2 ft 6 in. Sand and gravel, pale yellow depth 19½ ft	2. Meltwater deposits outwash over the till.	
12 ft Sandy gravelly mud; grayish brown and criss-crossed by upward-widening yellow streaks that are weathering zones along vertical cracks Bottom of ditch depth 31½ ft	1. A glacier deposits this material, till. The outwash deposit (2) covering this shows that the glacier melted off the area briefly after the till layer was laid down.	

ISGS 1979

Figure 2. Drift in the road cut at Moore Cemetery.

form springs. This bed is dry, however, because it underlies a narrow upland that doesn't catch much rain to recharge it.

Another good (but very steep) exposure of this drift is in the west bank of the creek, just over the ridge between the roadcut and the cemetery. The Sangamon Soil is not overgrown there and is easily seen. (On both outcrops, scrape off the loose soil and washed earth to reveal the true colors and textures of the deposits.)

Glacier tracks. The immense glaciers that covered the land and disappeared left behind four kinds of features or tracks to show where they passed: glacial landforms, foreign rocks, glaciated rocks, and till. The last three features can be collected from the till in the roadcut.

Glacial landforms are the distinctive plains, mounds, hills, and ridge lines made by flowing glaciers and the meltwater streams running across them. Three mounds in the field trip area are such landforms: Coops Mound and its smaller companion about 2 miles northeast of here and Brushy Mound, a mile north of Stop 7. The mounds have been identified as kames—piles of sediment that meltwater streams heaped in ice-walled channels or beside the glacier.

A great many of the pebbles and cobbles in the roadcut are foreign rocks from Canada and the states north of Illinois. They do not come from Illinois bedrock. Probably the most easily recognized foreign rocks are the granites and granite gneisses—some of these are pink or red rocks that contain black, glittering crystals. In the gneisses the black crystals run through the rock in streaks or lines. Igneous and metamorphic rocks do not form the bedrock at the surface in Illinois, so all of them we find in the drift have been carried here from the north.

Glaciated rocks are pebbles and cobbles with one or several very flat, scratched sides. Rocks frozen in the bottom of a flowing glacier and dragged across bedrock have their sides ground flat. The flat sides are called "facets" and are marked by sets of parallel scratches and grooves. Cobbles and pebbles that turned in the ice have several facets. The surface of glaciated bedrock is also scratched and grooved. Only glaciers leave these distinctive "footprints".

Till is the sandy gravelly mud deposited by glaciers. Glaciers make till as they scuff rock and earth off the land they flow across and knead and grind it in their ice. Till deposits are smeared down on the land as the ice flows or are let down when it melts. The key characteristic of till is its mixture of all grain sizes—chiefly clay and silt (flour sand) mixed with a large proportion of sand and gravel and with a few cobbles and boulders. Only landslides produce similar mixtures of sediment sizes.

At mile		
6.85	Leave Stop 2. Turn left (west) onto the blacktop road and return to the T-intersection at the top of the hill. Go...	0.15 mile
7.0	Turn left (south). Return to Carlinville following the route as it turns west and south. Go...	3.2

The view. To the left along the first half mile of this leg is a view across the Macoupin Creek Valley and to the right, a view of the glacial plain. As a rule, the hills and valleys in this area are erosional features cut down into the nearly flat glacial plain. Exceptions to the rule are Coops Mound and its companion and Brushy Mound.

10.2	Turn right (west) onto Nicholas Street and enter Carlinville. Go...	0.7
10.9	Stop at College Avenue by the Blackburn College Entrance. Go straight ahead four blocks... Return to Map 1.	0.2
11.1	Stop. Turn left (south) on Charles Street. Stop ahead at Maple Street, First Street North, East Main Street, First Street South and Hoehn Street. Go...	0.8
11.9	Stop. Turn right (west) onto Hoehn Street. Go...	0.25
12.15	Stop. Turn left (south) onto Broad Street. Go...	0.2
12.35	Stop 3 is at the bottom of the hill in the stream bed on the left side of the road.	

STOP

3

STOP 3. An outcrop of the Carlinville Limestone Member. NW¼SE¼NW¼ Sec. 33, T. 10 N., R. 7 W., Macoupin County, Carlinville West 7.5-minute Quadrangle.
CAUTION: Avoid the water in the creek. It is sometimes contaminated with sewage.

A massive bed of the Carlinville Limestone, 4 to 5 feet thick, is exposed just below the spillway and in the creek banks downstream. The unweathered rock is medium gray—the weathered rock is yellowish brown. The beds are dipping slightly to the southwest and are broken by joints (near vertical cracks). The joints in the upper part of the limestone, which is exposed along the banks, have been widened through the ages by water trickling into them and dissolving the stone. The surface of contact between the top of the limestone and the sediments above (drift, alluvium, and construction fill) is an unconformity. The limestone bed is about 200 feet above the top of the No. 6 Coal here.

The fine grain of the rock and the fossils in it indicate that at the time of deposit, the Carlinville Limestone was a mixture of dark chalky ooze and shell sands that had accumulated on the bottom of a shallow sea covering this region. The fossils are most visible on the weathered rock surfaces where water dissolving the rock has left them standing in relief.

The Carlinville Limestone is one of the thickest limestones in the area, but it is not thick enough to supply the volume of stone needed to operate a modern quarry. In earlier times it has been quarried locally and on a small scale for bridge abutments, foundations, and the like. Because the rock is thick-bedded, solid, and not apt to be split by freezing water—as the outcrop shows—it makes a good ordinary building stone.

The light olive-gray limestone riprap covering the stream banks below the spillway is quarried from the Mississippian beds exposed along the Illinois River Valley. The rock contains fossils, pyrite nodules, chert bands, and dark green glauconite films on parting surfaces.

At mile

12.35	Leave Stop 3. Continue south on Broad Street to its end. Go...	0.2 mile
12.55	At the end of Broad Street, turn right (west) onto Orange Street. Follow Orange Street westward across the railroad and through the jog to the right beyond the tracks. Go...	0.3

The Carlinville Tile Company. The company's plant and pit operated in the area just beyond the end of Broad Street. Pennsylvanian shale and glacial drift from the pit were mixed to make brick, drain tile, and hollow block and tile. In 1952, John R. Ball reported that it had not been operating for some time.

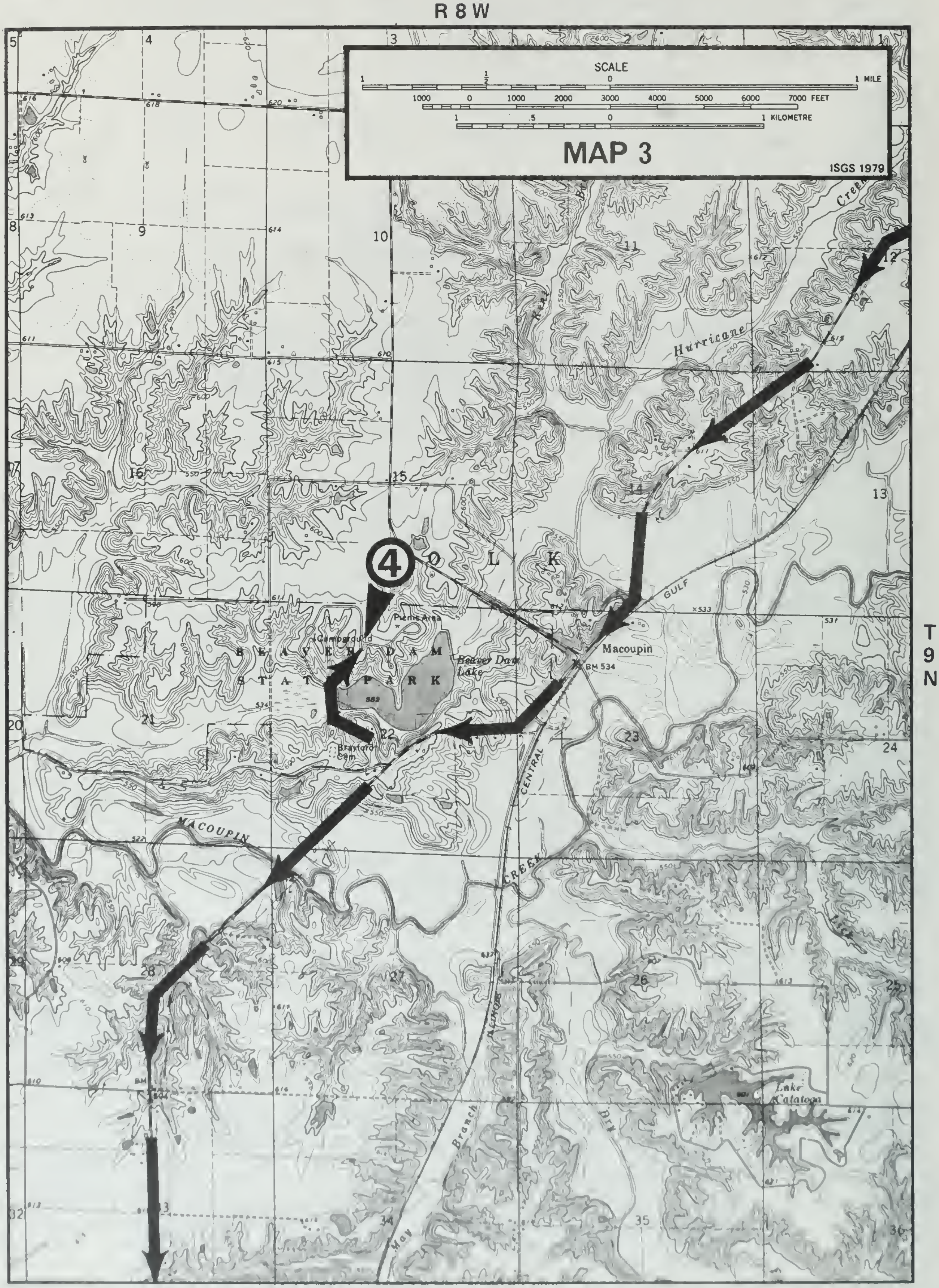
The South Mine. Our cover shows the ruined works of the shaft mine, which is located about 250 yards south of Orange Street on the west side of the railroad. Operated by the Carlinville Coal Mining Company and several others, it mined the Herrin (No. 6) Coal and was abandoned in 1954. Two older mines, which are not shown on the map, were located just south of it.

12.85	Stop at Locust Street. Go straight ahead, following the road as it turns left, downhill onto the valley. Go...	0.8

The Moody Company. The mine symbol west of the route shows the location of the Moody Company's clay pit and plant. Three round, down-draft kilns produced sand-mold brick, common brick, drain tile, and building block. From the shallow pit were mined the uppermost 6 feet of loess from which limestone and dolomite grains have been leached. This clay burned red.

13.65	From the point where the road rises out of the valley to the plain and turns left, straight south, go...	0.4
14.05	Turn right (west). Go...	0.75
14.8	Turn right (north) and go to the Shipman Road. Go...	0.2
15.0	Turn left (southwest) onto the Shipman Road. The next landmark is the Illinois Central Gulf Railroad overpass on map 3. Go...	1.6

The railroad prairie. Remnants of prairie survive along the railroad right-of-way and in a narrow wild area north of the railroad overpass at mile 16.6, between the tracks


R 8 W
T 9 N
SCALE
1 MILE
7000 FEET
1 KILOMETRE
MAP 3
ISGS 1979
4
O L K
BEAVER DAM STATE PARK
Beaver Dam Lake
Picnic Area
Campground
Macoupin
BM 534
Hurricane Creek
GULF
CENTRAL
MACOUPIN CREEK
May Branch
Lake Catatoga

and the road. Prairie once grew across half the county, covering the wet, poorly drained glacial plain. However, by the mid-19th century, farmers who had earlier settled the more manageable wooded valleys were draining the upland plain and plowing the prairies under. Today in Macoupin County and in Illinois, the beautiful prairie plant communities survive only in out-of-the way places where the land is not grazed or mowed or cultivated and where burning kills trees and brush.

At mile

16.6	Go under the railroad overpass and continue straight ahead. We are on the divide between Hurricane Creek and Macoupin Creek. Go...	1.6
18.2	Begin to descend the hill into the Hurricane Creek Valley. This is the gap in the divide through which Hurricane Creek was diverted by stream piracy in prehistoric time. Follow the road to the entrance to Beaver Dam State Park. Go...	1.5
19.7	Turn right (west) into the park entrance. Follow the road past the ranger station, downhill past the dam, and uphill to the picnic areas for a lunch stop, Stop 4.	

STOP 4. Beaver Dam State Park. NE¼NW¼ Sec. 22, T. 9 N., R. 8 W., Macoupin County, Plainview 7.5-minute Quadrangle.

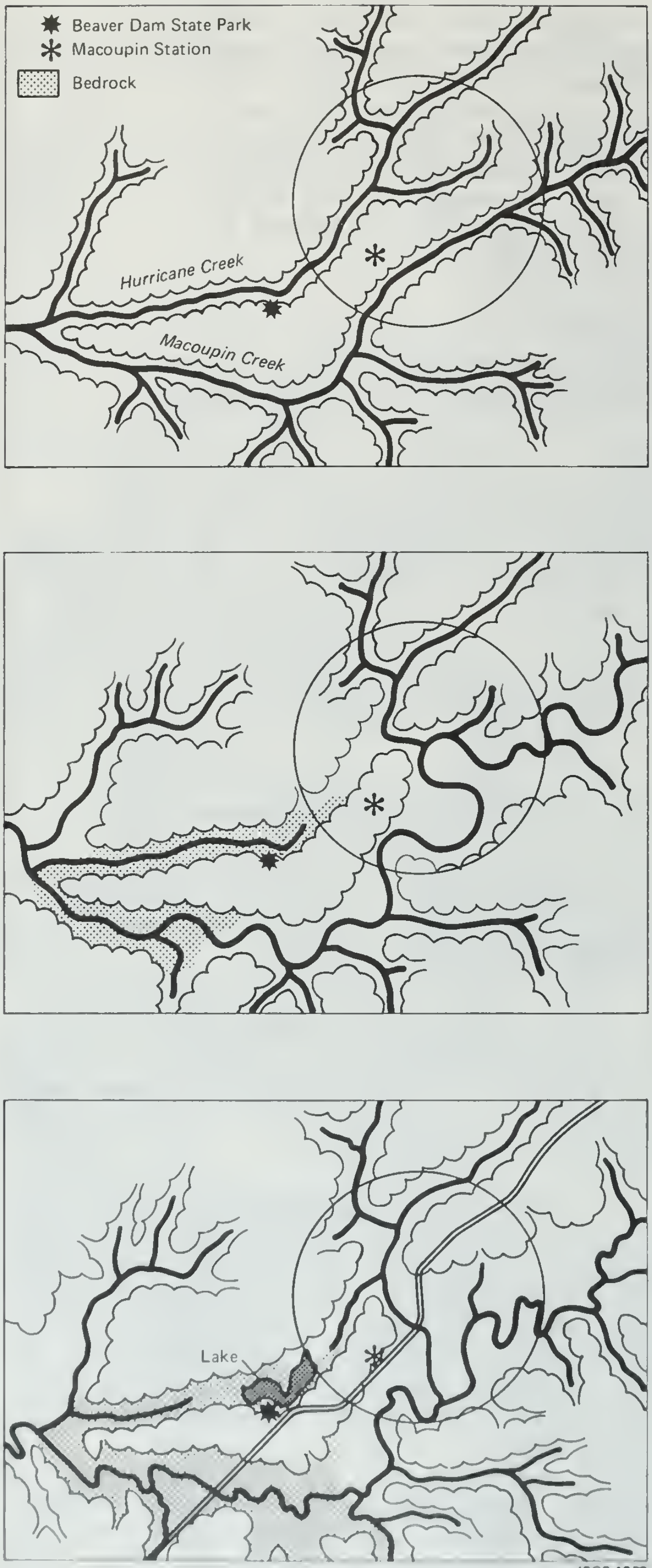
STOP 4

Beaver Dam Lake. The spring-fed lake occupies a segment of Hurricane Creek's lower valley that the creek abandoned in prehistoric time. Figure 3 shows how this diversion may have occurred.

Local tradition has it that the first lake in this valley was formed by a beaver dam that was evidently built where the peninsula juts into the present lake. In the 1890s a club enlarged the first lake by building two dams, doubling the water's depth. After the site became a state park in 1947, the dams were further improved to create the present 59-acre lake.

The Trivoli Sandstone Member. The brown Trivoli Sandstone crops out in this vicinity along Macoupin and Hurricane Creeks near the base of the valley sides. The rock formed from a sand deposit laid down by delta or floodplain streams during the Pennsylvanian Period. Outcrops of the Trivoli Sandstone can be seen near the south end of the west dam. Several are along the south shore of the lake within 300 yards of the dam. Another is opposite the south end of the dam, about 60 yards west of the road in a small borrow pit at the base of the hill. The Trivoli Sandstone is about 150 feet above the No. 6 Coal here and it may be 3 to 10 feet thick.

The Macoupin. The American settlers named this county after its largest stream, Macoupin Creek, and the creek was named by the Indians whom French travellers and colonists found living here more than 200 years ago. The Indian word, which the French rendered "macopine" and the English "macoupin", was the name of an important wild food plant that grew in marshy places and shallow streams like Macoupin Creek.



1. As the last glacier to cover the area wasted away, its meltwater and the rain and snow water flooded across the emerging land and started cutting the valleys of Macoupin Creek, Hurricane Creek, and other streams into the till plain. Hurricane Creek at this time joined Macoupin Creek about 1.5 miles west of Beaver Dam State Park. Only a narrow divide separated the two streams. Tributaries of both were cutting into it.

2. As time passed the creeks cut deeper into the till plain, finally cutting down into bedrock between Macoupin Station and their junction. Later, changes in drainage levels caused the larger Macoupin Creek to begin making side-cutting meanders; it widened its valley—more in the softer drift-walled section east of Macoupin Station and less in the harder bedrock section down stream. Hurricane Creek, a much smaller stream, did not meander; west of Macoupin Station, it flowed in the narrow, bedrock-sided valley we see today. At this time, it appears that one of Macoupin Creek's wide-flung meander loops cut through the divide between itself and the tributary to Hurricane Creek.

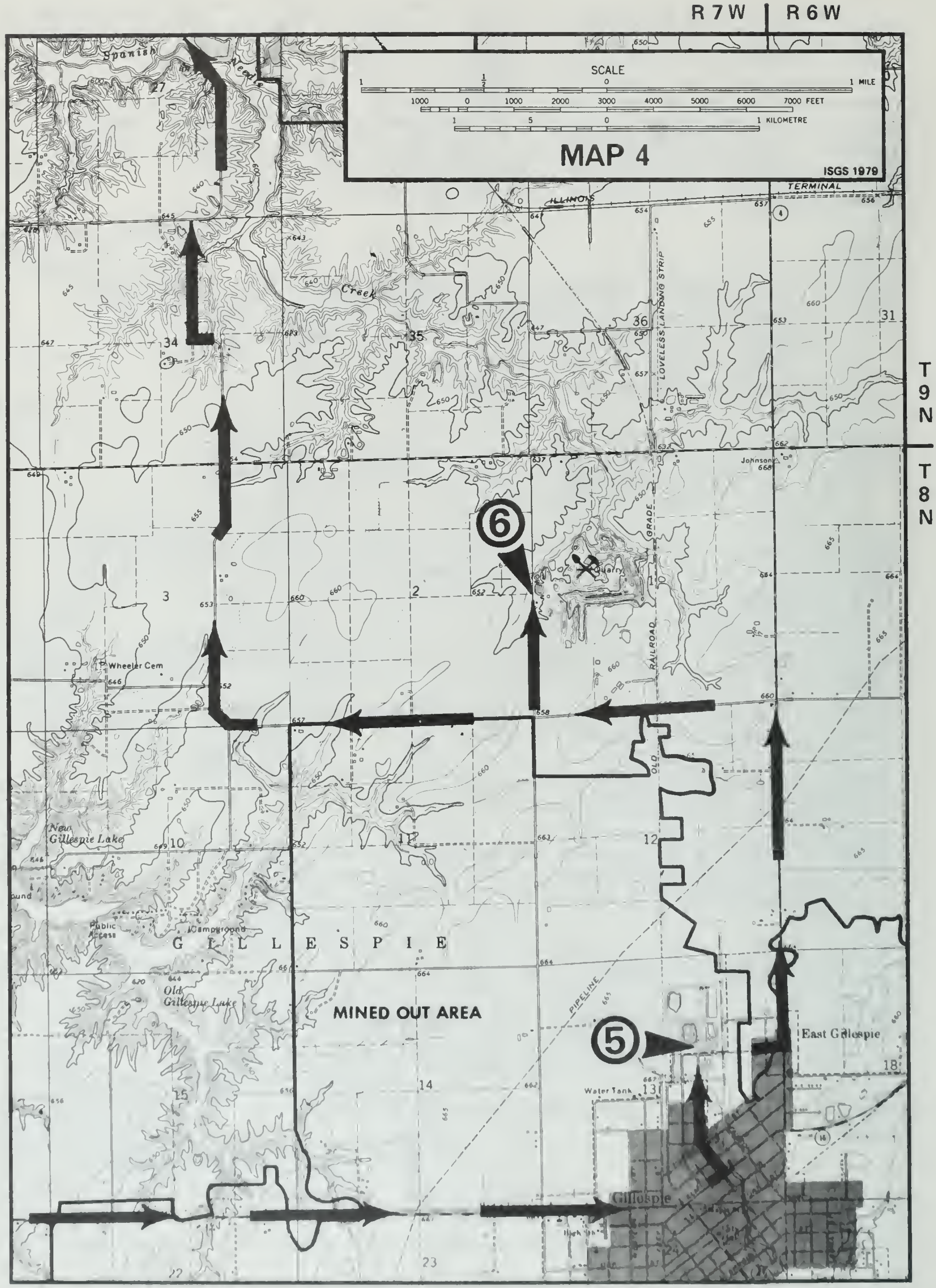
   At first only the captured tributary would have flowed into Macoupin Creek. But we can guess that occasional very high floods, the bottle-neck effect of Hurricane Creek's narrow bedrock valley, and probably other causes would have caused floodwater to back up the tributary, overflow into Macoupin Creek, and finally cut the connecting channel low enough to divert Hurricane Creek through the present gap in the divide.

3. Today Hurricane Creek continues to widen the gap in the divide as it cuts against its west side. The abandoned lower valley of Hurricane Creek is a marshy lowland, partly flooded at highwater levels, and quite suited to the dam-building activities, first of beavers and later of people.

Figure 3. Stream piracy and the diversion of Hurricane Creek (H. B. Willman, 1979, personal communication; Lee, 1926).

There has been some confusion about the identity of the Macoupin plant because the early descriptions of it are incomplete and suggest several aquatic plants. However, Dr. William E. Werner, Jr., Head of the Biology Department of Blackburn College, identifies the Arrow Arum—*Peltandra virginica*— as the plant described by the most significant characteristics mentioned in the early accounts. The Macoupin harvested by the Indians—like the Arrow Arum—was reported as growing in shallow water and the large roots gathered for food were poisonous or inedible until they had been specially cooked. The county's sesquicentennial logo (page 1) depicts the plant.

At mile		
19.7	Leave Stop 4. Return to the park entrance and turn right (southwest) onto the Shipman Road. After the route goes off Map 3, use the Route Map on the back cover until the route goes onto Map 4 two miles west of Gillespie. Go...	3.6 mile
23.3	At the curve, bear right to continue straight onto the southbound blacktop road that crosses the railroad. Cross the railroad. Go...	1.1
24.4	Curve left (east), following the blacktop road. Go...	0.5
24.9	Curve right (south) at the T-intersection, following the blacktop road. Go...	1.0
25.9	Curve left (east), following the blacktop road. Go...	0.25
26.15	T-intersection. Go straight ahead (east) to the stop at State Route 16. Go...	1.4
27.55	Stop. Go straight ahead (east) on Route 16 to the radio tower at the Gillespie city limits. Go...	6.4
33.95	Pass the radio tower and enter Gillespie. Continue straight ahead (east) to the curve, then bear left (northeast) on Elm Street to the stop. Go...	0.65
34.6	Stop. Continue straight ahead on Elm two blocks to Clinton Street. Go...	0.2
34.8	Turn left (northwest) onto Clinton Street. Bear right in two blocks and continue north to the end of Clinton Street. Go...	0.5
35.3	Stop 5, at the end of Clinton Street.	



R 7 W
R 6 W
SCALE
1 MILE
7000 FEET
1 KILOMETRE
MAP 4
ISGS 1979
T 9 N
T 8 N
Spanish
Needle
Creek
ILLINOIS
TERMINAL
LOVELESS LANDING STRIP
OLD
RAILROAD
GRADE
Quarry
Johnson
Wheeler Cem
New Gillespie Lake
Public Access
Campground
G I L L E S P I E
Old Gillespie Lake
MINED OUT AREA
PIPELINE
Water Tank
East Gillespie
Gillespie
6
5
27
34
35
36
31
3
2
1
10
11
12
15
14
13
18
22
23

STOP 5. The slack piles of the abandoned Little Dog Mine. S½ of the NW¼ and N½ of the SW¼NE¼ Sec. 13, T. 8 N., R. 7 W., Macoupin County, Gillespie North 7.5-minute Quadrangle.

"Slack" is a local name given to the waste rock and mud that the mine preparation plant washed out of the coal to clean it for sale. Although the slack contains rocks weighing several pounds—mostly pyrite and shale—the bulk of it is powder. The powder contains coal dust, clay, pyrite, and other rock particles—the materials commonly in the coal seam or in contact with it. Translucent, colorless gypsum crystals less than 2 mm long can be found in the grayer slack where they grew. (Gypsum is formed where the sulfuric acid produced by the decomposition of pyrite reacts with limestone.) Oil used to treat the shipped coal may also be an ingredient of the slack.

The dry slack material is firm underfoot but every step scuffs it into powder that flies in the lightest wind. It crumbles to a soft powder between the fingers and soils them. Water running off the piles easily erodes the material and cuts deep, narrow, sinuous gullies down their sides. The ponds on the east side of the property contain vivid red water, a sign of acid runoff. The mud flats around the piles have white mineral crusts that grow as the mineralized water is drawn up through the waste soil to its drying surface.

An x-ray diffraction analysis of a powdered sample of white crust indicates it is a mixture of several water soluble hydrated iron sulfate minerals, which Survey mineralogist H. D. Glass identifies as rozenite, $FeSO_4 \cdot 4H_2O$ and halotrichite, $Fe''Al_2(SO_4) \cdot 22H_2O$. Jarosite, $KFe_3(SO_4)_2(OH)_6$, is also present. These minerals commonly form as pyrite weathers to form sulfuric acid that reacts with elements in the clay, shale, and other rock in the slack.

Waste piles of this sort are found at many underground mines that operated before environmental protection laws regulated the disposal of mine wastes. Fine coal has been recovered and sold from a few of the older waste piles. Some provide fill material and inferior road-surfacing rock.

The Little Dog Mine slack piles have caused a number of problems for the townspeople. Residents complain that when they are dry, high winds whip clouds of dust off them. During heavy rains, flash floods run off the mine property, down through town, and into the headwaters of Cahokia Creek. The water carries the dark mud from the piles onto lawns and streets and partly fills the ditches. Because the mud and run-off water is acidic, it stains paint and sidewalks with iron and pollutes the creek. About a year ago a deposit of slack mud several feet thick that the creek deposited along its banks in the city cemetery caught fire by spontaneous combustion. The underground fire was discovered when two children playing by the stream broke through the material's crust and burned their feet. The mine property is outside the city limits but the uses made of it for shooting, dirt-bike riding, and play and the nuisances are concerns of the city residents. However, the property is presently outside their official control.

<u>The Benld Meteorite.</u> Benld, a small ex-mining town 3 miles south of Gillespie, became an astronomical and geological landmark on September 29, 1938. Between 9:00 and 9:10 a.m. of that day, a meteorite fell with a sharp, cracking report and struck a car parked in a garage near the town. The 3.75-pound pitted, black rock shot through the garage roof and through the roof, back seat, and floor of the car, finally bouncing off the muffler and lodging in the seat springs. The meteorite is about 6 inches across. Its stony interior is gray

and flecked with metallic grains and rust spots. It is covered with a black fusion crust that was made as the friction of the hypersonic flight through the air burned the outside of the rock. The Benld Meteorite is classified as a stony meteorite—an H6 chondrite. It and parts of the garage and car it struck are exhibited in the Field Museum of Natural History in Chicago.

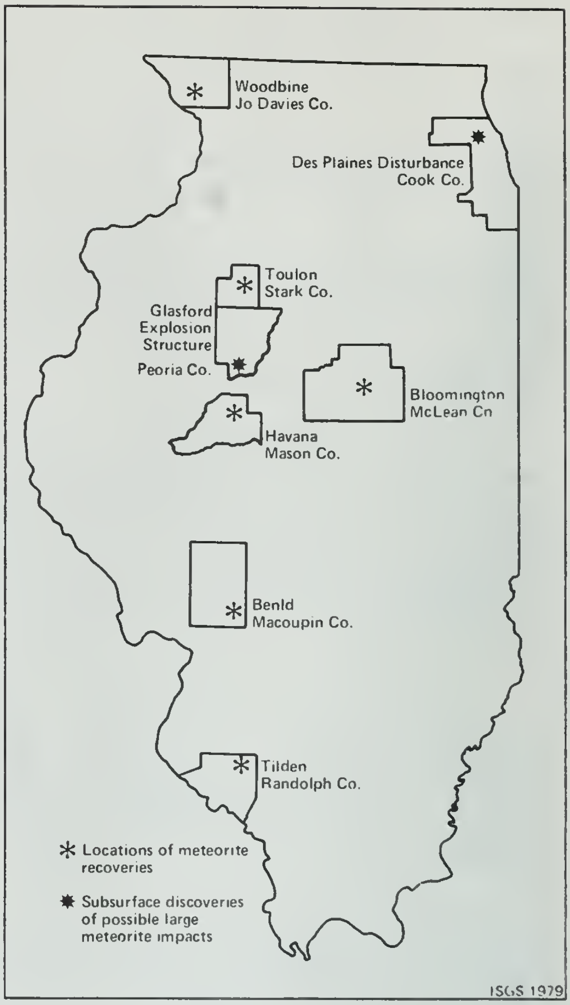


Figure 4. Locations of meteorite recoveries and possible impact sites in Illinois. (Adapted from Sipiera and Leary, 1976.)

Only six meteorites and two possible meteorite impact sites have been found in Illinois (figure 4), but rocks from space are continually colliding with our Earth and its atmosphere. One estimate is that more than 100,000 tons of meteoric material fall to Earth each year. Happily, most of the larger pieces are powdered by the shock of their miles-per-second impacts with the air. Possibly 100 grams of meteoric dust fall per square kilometer of the Earth's surface. Recent studies estimate that a 100-ton body enters the Earth's atmosphere daily, a 1,000-ton body monthly, a 15,000-ton body yearly, a 100,000-ton body every 10 years, and a million-ton body every century.

Large meteorites do strike the Earth, even if infrequently by human standards. Meteor Crater near Flagstaff marks the impact about 22,000 years ago of an iron meteorite in the 100,000-ton class. The meteorite was probably at least 80 feet and not more than 325 feet in diameter. Its strike released energy equivalent to a 10-megaton explosion and blew out a crater .75 mile across. More than 100 meteorite impact structures of this kind have been found on Earth. In Illinois, two circular areas containing broken and jumbled blocks of bedrock have been discovered that are almost certainly meteorite impact sites. The Des Plaines Disturbance is 6 miles in diameter; the Glasford Explosion Structure, 2.5 miles. Both are buried—one under bedrock, the other under drift—and geologists found them by studying samples and records of wells penetrating the structures.

Meteorites and moon rocks contain the only evidence we can reach of the earliest history of the Earth and Solar System, of the nature of planet cores, and of some physical processes occurring in space. Large meteorite impacts on the Earth have created mineral resources. For example, when an asteroid about 5 miles in diameter struck near Sudbury, Ontario, approximately 1.8 billion years ago, it caused fluids to well up from 12 miles deep in the crust and form the great nickel-copper ore deposits mined there.

At mile

35.3	Leave Stop 5. Turn right (east) onto Illinois Avenue. Go...	0.35 mile
35.65	Stop. Turn left (north) onto State Route 4 and go to Quarry Road. Go...	1.4
37.05	Turn left (west) onto Quarry Road. Go...	1.0
38.05	Turn right (north) into the farm lane, which is the entrance to Stop 6. Follow the lane for 0.5 mile into the quarry area.	

STOP 6. The abandoned Gillespie Quarry of the Midstate Stone Corporation. S½ of the NW¼ and N½ of the SW¼ Sec. 1, T. 9 N., R. 7 W., Macoupin County, Gillespie North 7.5-minute Quadrangle. NOTE: Please obtain permission to enter the quarry from Mr. Walter Theobald, Route 1—Box 114, Gillespie, IL 62033.

STOP 6

The quarry mined the Shoal Creek Limestone Member for about 10 years and closed in 1976. Concrete aggregate, ag lime, and "road pack" (a mixture of dust and chips) were produced. Because the quarry pits are filled with water, we cannot examine the working faces, but the average thickness of the limestone is said to have been about 12 feet. Now that this quarry and the one 6.5 miles east of Carlinville are closed, stone is trucked from quarries near the Illinois Valley, from the Cain and Alton areas and from Nokomis to the east. The hauling distance from these quarries averages about 30 miles to the center of Macoupin County. A local quarry working a thick, pure limestone under thin overburden could easily compete with the distant quarries, but such quarry sites are rare in this region.

The Shoal Creek Limestone is Pennsylvanian in age. It lies about 275 feet above the No. 6 Coal in the field trip area and about 75 feet above the Carlinville Limestone (Stop 3). The fossils in the Shoal Creek Limestone are related to present-day marine animals, so the rock is considered to have been deposited in a sea as a chalk mud mixed with shells and shell sands. Examine pieces of rock closely with a hand lens—they are crowded with fossils!

At mile

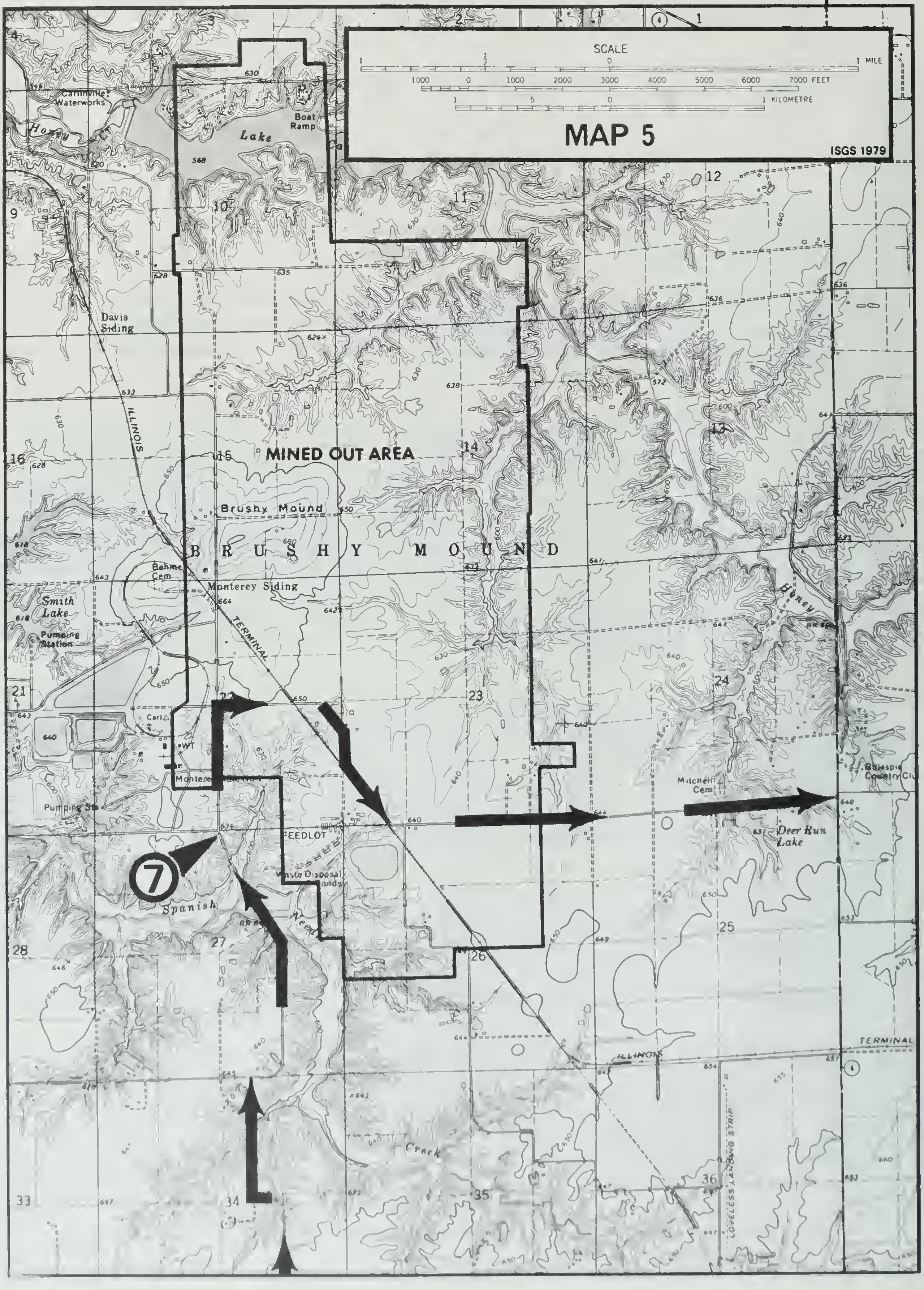
38.05 Leave Stop 6 and return to the road entrance. Turn (right) west onto the road. Go... 1.3 miles

WARNING: FOR 5-TON AND LARGER VEHICLES:

> There is a bridge on the route ahead with a 5-ton load limit. Heavier vehicles should turn left (east) and return to Route 4. Turn left (north) and go 3 miles to Deer Run Lake Road. Follow the route on Map 5 backward to Stop 7.

39.35 T-intersection. Curve right (north). Follow the road north to the T-intersection through a jog and a sharp left-and-right curve. Go... 2.2

R 7 W
R 6 W
T 9 N


SCALE
1 MILE
7000 FEET
1 KILOMETRE
MAP 5
ISGS 1979
Carlinville Waterworks
Boat Ramp
Lake
Davis Siding
ILLINOIS
MINED OUT AREA
Brushy Mound
B R U S H Y M O U N D
Behme Cem
Monterey Siding
TERMINAL
Smith Lake
Pumping Station
Mitchell Cem
Gillespie Country Club
Deer Run Lake
FEEDLOT
Waste Disposal Ponds
7
Spanish
Crack
Honey
LOVELESS LANDING STRIP
ILLINOIS
TERMINAL
MINED OUT AREA

41.55 Turn right (east) at the T-intersection and follow road as it curves north and crosses Spanish Needle Creek. Go... 1.15

42.7 Stop 7 is at the T-intersection where there is a good view of the Monterey No. 1 Mine. End of trip.

A road that will return you to State Route 4 is shown on Map 5.

STOP 7. The Monterey No. 1 Mine. SE corner of the SW¼ Sec. 22, T. 9 N., R. 7 W., Macoupin County, Gillespie North 7.5-minute Quadrangle.

STOP 7

Coal has been mined in Macoupin County for more than 110 years. State Geologist A. H. Worthen (1873) noted that eight mines were operating in the county in 1871 near Bunker Hill, Staunton, Carlinville, Virden, and Girard. In the 95 years for which production is reported, Macoupin County mines produced a total of about 284,312,000 tons of coal—almost entirely from the Herrin (No. 6) seam. A belt of thick No. 6 coal underlies the eastern half of the county, roughly along the line of State Route 4. The seam is generally 6 to 8 feet thick in this belt, and so the larger mines have been located along it.

Two mines now operate in Macoupin County: the Freeman Coal Company's Crown No. 2 Mine between Girard and Virden and the Monterey No. 1 Mine. In 1977, these two mines produced a total of 3,622,966 tons with an estimated value of $62,604,852. (In 1977 the Monterey No. 1 Mine produced 4.9 percent of the total production in Illinois.) In 1977, total coal production in Illinois was 53,880,000 tons with an estimated value of $931,054,000. About 83 percent of Illinois coal is burned to generate electricity.

(About 0.95 pound of coal is required to generate one kilowatt hour (kWh) of electricity. How much electricity do you buy each month or year? How much coal has to be mined to provide your needs? The average residential user consumes about 8,000 kWh per year.)

The No. 1 Mine. The Monterey Coal Company is an operating subsidiary of the Carter Oil Company, a subsidiary of the Exxon Corporation. The mine began operating in 1970. The No. 6 Coal in the mine area has an average thickness of 7 feet and lies about 300 feet below the land surface. During the 25-year life of the mine, an estimated 80 million tons of coal will be mined and as much coal will be left as pillars to prevent the collapse of the mine roof and the sinking of the land surface.

The coal is mined with electric-powered machines called continuous miners. These machines can rip 12 tons of coal per minute out of the seam and load it on electric shuttle cars. The shuttle cars haul the coal to the conveyor belt system that carries it up the 1210-foot slope tunnel to the preparation plant at the surface.

The preparation plant. Figure 5 identifies the different parts of the plant. The slope conveyor belt (2) can deliver 1,800 tons per hour to the breaker house (3). Here the coal is screened and the larger-than-6-inch chunks are crushed in the rotary breaker. Next a belt (4) delivers the coal

to the raw coal storage silo (5) from which it is conveyed to the washery building (6). In this facility, coal is washed, crushed, screened, and dried to make the "2 X 0 washed coal" product, which has particle sizes ranging from 2 inches to .25 mm. A conveyor (7) carries the washed coal to the two clean coal silos (8) where it is stored until it is conveyed to the loading station (9) to be loaded into the unit trains. All of the coal is shipped to power plants where it is burned to generate electricity.

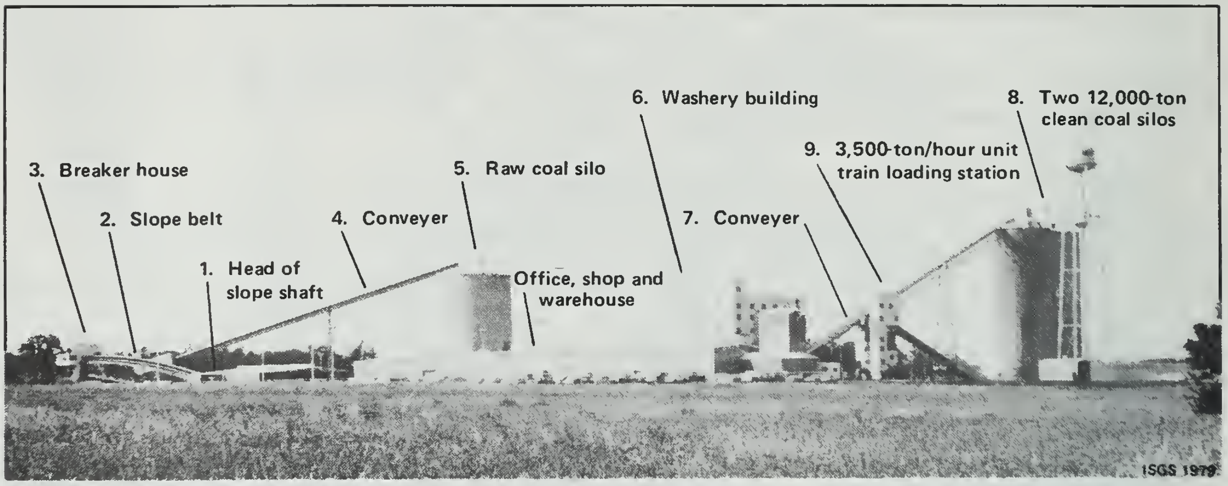


Figure 5. A view of the Monterey No. 1 preparation plant from Stop 7.

Waste handling. The No. 1 Mine processes and disposes of its wastes on its own property. Human waste is treated in a sewage treatment plant. The water used to wash the coal is recycled. Washwater and fine wastes are sent to the slurry pond where the muds settle out and the cleared water is piped to a second pond. From this pond the water flows into a 100-acre lake a mile northwest of the plant. The lake, which supports fish and wildlife, supplies as much as 800,000 gallons of water daily to the mine and preparation plant.

Rock from the breaker and washing jigs is compacted to make slurry pond dikes—as the pond fills with waste its sides are built higher and higher. When the slurry pond dikes are 60 feet high, the pond will be drained, the dry wastes covered with layers of clay and soil, and the area seeded.

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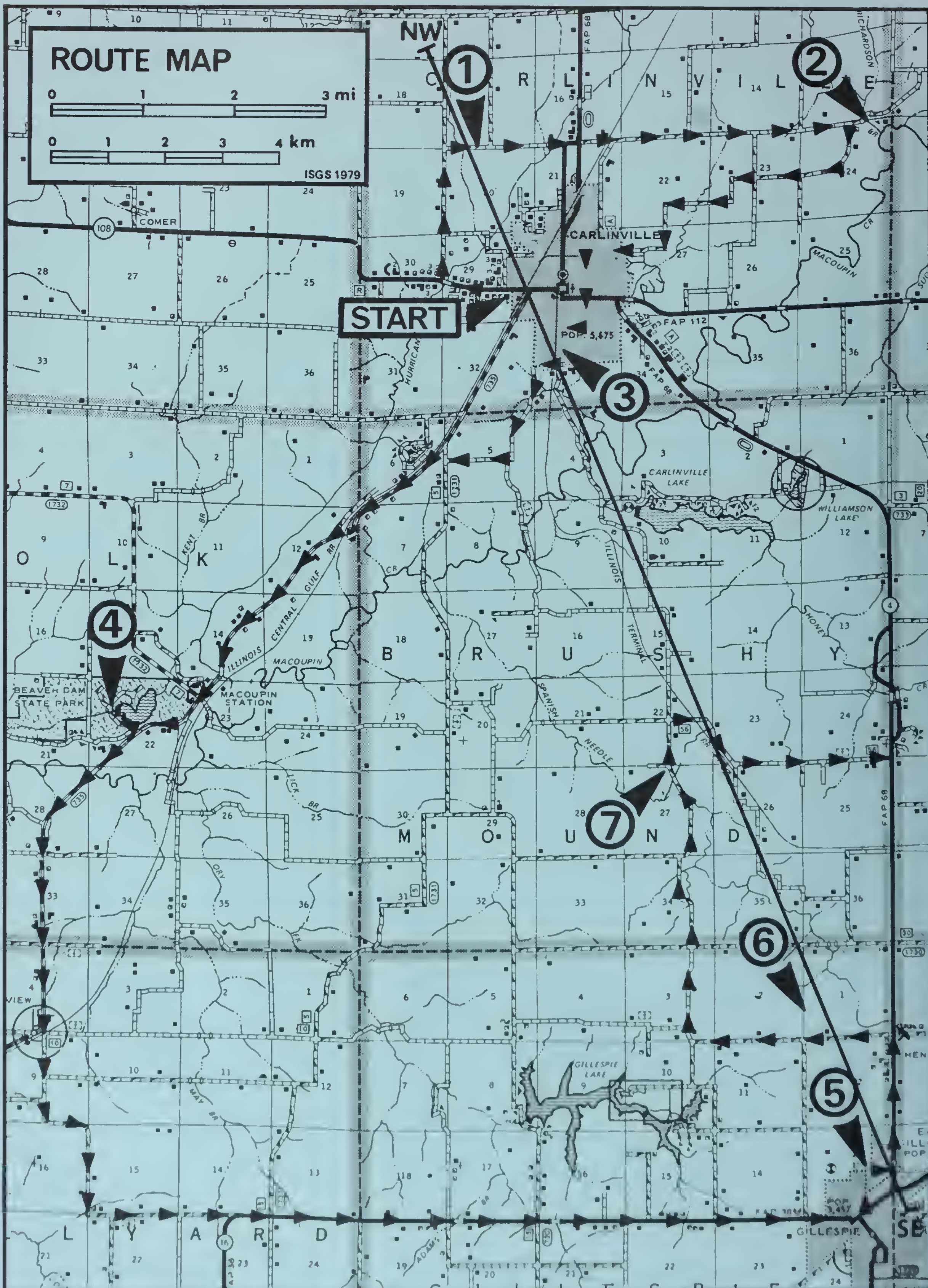

ROUTE MAP
0 1 2 3 mi
0 1 2 3 4 km
ISGS 1979
NW
SE
START
CARLINVILLE
POP. 5,675
CARLINVILLE LAKE
WILLIAMSON LAKE
COMER
BEAVER DAM STATE PARK
MACOUPIN STATION
GILLESPIE LAKE
GILLESPIE
ILLINOIS CENTRAL GULF RR
ILLINOIS TERMINAL
MACOUPIN CR
HURRICANE
SPANISH NEEDLE
LICK BR
KENT BR
MAY BR
RICHARDSON
HONEY
FAP 68
FAP 112
C A R L I N V I L L E
O L K
B R U S H Y
M O U N D
L Y A R D